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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---------------------------------------------------------------------------------------------------------------|-------------|----------------------|---------------------|------------------|
| 10/694,826 | 10/29/2003 | Tamotsu Owada | 032060 | 9457 |
| 38834 | 7590 | 02/08/2005 | EXAMINER | |
| WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP 1250 CONNECTICUT AVENUE, NW SUITE 700 WASHINGTON, DC 20036 | | | | PAREKH, NITIN |
| ART UNIT | | PAPER NUMBER | | |
| | | 2811 | | |

DATE MAILED: 02/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H.A

| | | |
|------------------------------|---------------------------------|-------------------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 10/694,826 OWADA ET AL. | |
| | Examiner Nitin Parekh | Art Unit 2811 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 13 December 2004.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) 1-11 and 23-30 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 12, 13, 15-17, 19, 20 and 22 is/are rejected.
- 7) Claim(s) 14, 18 and 21 is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 29 October 2003 is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____. |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>4</u> . | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Applicant's election without traverse of Group I, claims 12-22 in Paper No. 2 is acknowledged.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 12, 13, 15-17, 19, 20 and 22 rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuura (US Pat. 6737746) in view of Loboda et al. (US Pat. 6593655).

Regarding claims 12 and 13, Matsuura discloses a semiconductor device (Fig. 6) comprising:

- a semiconductor substrate (1 in Fig. 6)
- a copper wiring (7 in Fig. 6) formed above the semiconductor substrate
- a diffusion preventing film such as silicon carbide (SiC) layer (8 in Fig. 6; Col. 3, lines 45-50; Col.4, line 60) covering the copper wiring, and

- a first lower permittivity/low-k/low specific dielectric constant (SDC) insulating layer such as silicon oxycarbide (SiOC) layer (9 in Fig. 6) covering the SiC layer, the first SiOC layer having the SDC of less than 3.0 (Col. 4, lines 15-28) (Fig. 6; Col. 3, line 40- Col. 8, line 40).

Matsuura fails to teach the first SiOC containing hydrogen and having a carbon content of at least about 18 atomic (at.) %.

Loboda et al. teach a semiconductor device using hydrogenated SiOC layer having SDC of 3.0 or less (Col. 2, lines 10-20; Col. 4, line 16) and having a carbon content of 1-66 atomic % and hydrogen content ranging from 0.1-60 atomic % (Col. 2, lines 53-60) to achieve the desired dielectric constant and mechanical/electrical properties (Col. 2-5).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the first SiOC containing hydrogen and having a carbon content of at least about 18 atomic % as taught by Loboda et al. so that the desired dielectric constant and mechanical/electrical properties can be achieved in Matsuura's device.

Regarding claim 15, Matsuura and Loboda et al. teach substantially the entire claimed structure as applied to claim 12 above, wherein Matsuura further teaches forming a plurality of layers on the first SiOC layer, such plurality of insulating layers including low-

k layer such as SiOC (see 11 in Fig. 6) having the SDC of less than 3.0 (Col. 4, lines 15-28), which is lower than that of silicon oxide.

Regarding claims 16, 17 and 19, Matsuura and Loboda et al. teach substantially the entire claimed structure as applied to claims 12, 13 and 15 respectively above.

Regarding claims 20 and 22, Matsuura and Loboda et al. teach substantially the entire claimed structure as applied to claims 12 and 15 respectively above.

Allowable Subject Matter

4. Claims 14, 18 and 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Reasons for Allowance

5. The following is an examiner's statement of reasons for allowance:

The references of record do not teach either singularly or in combination at least the limitations "a second silicon oxycarbide layer formed on said first silicon oxycarbide layer, said second silicon oxycarbide layer having the carbon content at least 1 at% smaller than the carbon content of said first silicon oxycarbide layer", or "a second silicon oxycarbide layer formed on said first silicon oxycarbide layer, said second silicon

oxycarbide layer having the hydrogen content at least 2 at% larger than the hydrogen content of said first silicon oxycarbide layer" or "a second silicon oxycarbide layer formed on said first silicon oxycarbide layer, said second silicon oxycarbide layer having the carbon content at least 2 at% lower than the carbon content of said first silicon oxycarbide layer or the hydrogen content at least 2 at% larger than the hydrogen content of said first silicon oxycarbide layer" in a semiconductor substrate having a copper wiring being covered by a silicon carbide, a first silicon oxycarbide and a second silicon oxycarbide layer.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9318.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

NP

02-01-05

Nitin Parekh

NITIN PAREKH

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800